24 SOW Selection Nutrition

Current as of 09-25-13

TABLE OF CONTENTS

Page Number

CHAPTER 1
DIET/INTAKE PRIOR TO ARRIVAL

Key Points

- Carbohydrates (CHO) are the vital fuel for endurance and resistance activities, competitive athletic events, mental agility, and healthy living.
- Fats, the primary form of stored energy, are essential, but should be eaten in moderation.
- Proteins are essential for building and repairing body tissues; however, excess protein is converted to fat.
- Restore fluid balance by taking in enough liquids to replenish weight (pounds) lost plus an additional 25%.
- Performance decrements begin when only 2% of body weight has been lost.

"You Are What You Eat." Although this statement has not been proven, it is known that the foods eaten make a difference in performance, longevity, and quality of life. A car engine typically uses only one source of fuel, but the body can use carbohydrate, fat, protein, and alcohol. To a certain extent, the source of fuel is dictated by availability. In other words, the body tends to use whatever it has. The macronutrients, or energy-providing nutrients, are important in this respect. Without energy the body would starve, and performance would be greatly reduced. The three main sources of energy are:

- Carbohydrate.
- Fat.
- Protein.

These fuels are called "macronutrients" because they are eaten in large quantities unlike the micronutrients to be discussed later. This chapter will provide basic information about macronutrients and alcohol, which may be a dominant source of energy among SOF. In addition, information relating to portion size and hydration will be provided.

Fuels for Energy:

Carbohydrates

Carbohydrates, or CHO, are the preferred foods for endurance and resistance training, competitive athletic events, mental agility, and healthy living. CHO foods are the preferred energy source for all athletes and for SOF: CHO should not be restricted. In the past, CHO have been considered "off-limits" and many SOF have blamed weight gain on CHO. In addition, many fad diets promote protein and fat at the expense of CHO, but as a vital energy source, and restriction can degrade performance.

Carbohydrates exist in many forms, but the two major types of CHO are labeled simple and complex.

- Simple CHO include table sugar, honey, fruit sugars, milk sugar, brown sugar, corn syrup, maple syrup, corn sweeteners, high-fructose corn syrup, and molasses.
- Complex CHO include grains, fruits, seeds, potatoes, pasta, seaweed, algae, peas and beans, and all other vegetables.
- Complex CHO, starches and fibers, come from plant materials. The body digests starches, but it does not digest dietary fiber.

CHO are used in the body mainly as:

- Fuel for muscles, brain, heart, and other organs in the form of glucose; the brain requires 130 grams/day from glucose.
- Building blocks to make chemicals needed by the body.
- Chemical cement for joints and other structures in your body.
- Glycogen is the only CHO stored in humans.

Glycogen, stored in liver and skeletal muscle, is limited to about 500 grams and is depleted by three to four hours of heavy exercise; a 24-hour fast will use up liver glycogen stores.

Some people are phobic about eating CHO and believe that foods high in CHO are unhealthy and lead to weight gain. Fear not. That notion comes from muscle-building myths and low CHO diet fads that lack scientific evidence.

No one has ever been able to show that performance suffers from consuming potatoes, rice and bread. To the contrary, performance is enhanced by such foods. Rather, high-fat toppings (butter on bread, sour cream on potatoes, cream cheese on bagels, cream sauces on macaroni) may contribute to the notion that CHO are bad. Also, CHO that are highly processed with high fructose corn syrup and other highly processed sugars, are less healthy than whole food products, such as baked potatoes, brown rice, whole wheat pasta, and wheat bread.

One gram of Carbohydrate = 4 kcal.

Fat

Fat is a vital part of the diet as it adds taste to foods and satisfies hunger. However, not all fats are created equal. By understanding the different types of dietary fat, how it works in the body and using guidelines for daily fat consumption, excess fat can be eliminated from your diet and you can eat for better health.

Fat (technically fatty acids) is an essential nutrient and is usually classified according to its chemical form.

Type	Description	Examples
Saturated Fats	Solid at room temperature	Whole milk, cream, ice cream, whole milk cheeses, butter, lard, meat, palm kernel, coconut oils, cocoa butter
Polyunsaturated Fats	Liquid at room temperature	Safflower, sesame, soy, corn and sunflower-seed-oils, nuts seeds, fish
Monounsaturated Fats	Liquid at room temperature but may solidify in the refrigerator	Olive oil, canola and peanut oil, peanut butter, cashews, almonds, avocados
Trans Fats	Man-made from saturated fats	Cookies, crackers, other commercially baked goods, French fries, donuts, fried onion rings, other commercially fried foods

Fat serves a number of critical functions:

- Major form of stored energy: provides energy during exercise, in cold environments, and during starvation.
- Insulates the body.
- Helps transport other nutrients to places in the body.
- Protects organs.
- Serves a structural role in cells.

All the different types of fats are desirable, but too much fat is the primary dietary problem in our country. A high intake of fat is associated with many diseases, including:

- Heart disease.
- Obesity.
- Many forms of cancer.
- Diabetes.

The average American consumes 33% of daily calories as fat (52% carbohydrate and 15% protein). Total fat intake (saturated, trans, monounsaturated, polyunsaturated) should be adjusted to fit total caloric needs. It is recommended that no more than 35% of total calories come from fat. Saturated fat intake should not exceed 10% and the balance should come from mono- and poly-unsaturated fats. Trans fat intake should be less than 1% of total calories each day.

One gram of FAT = 9 kcal.
Fat provides more than twice the energy supplied by CHO and protein.

Protein

Protein seems to be the preferred food among SOF to consume, based on the number of protein drinks and sports bars used in place of "real food." Also, people like to eat high protein foods because they think protein makes them grow "big and strong." Are they correct? Let's take a look at protein and what it really does.

CHO and fat consist of carbon, oxygen, and hydrogen; protein consists of these atoms, plus nitrogen, which is essential for life. Proteins are made up of amino acids—small building blocks hooked together in various orders. Although over 20 different amino acids are part of our body, only 10 are "essential amino acids" (EAA) because our body cannot make them; they must be obtained from protein in the diet. Failure to obtain enough of the 10 EAA, in the right balance, may result in degradation of other proteins, such as muscle, to obtain the one EAA that is needed. Unlike fats and starch, the human body does not store excess amino acids for later use—the amino acids must be obtained from the food every day.

The 10 EAA, in alphabetical order, are arginine (required for the young, but not for adults), histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.

Proteins vary in size, depending on how many amino acids are linked together, and each one performs different functions in the body. Although they can provide energy, protein is not a main source of energy, like carbohydrates and fat. Some functions of protein are:

- Muscle contraction.
- Formation of muscle, hair, nails, skin, and other tissues.
- Direct energy production.
- Repair of injuries.
- Transport fats, vitamins and minerals around the body.
- Structural roles for every part of the body.

Protein needs are determined by age, body weight, and activity level. Many athletes believe that if they eat more protein, their muscles will increase in size, but this is not true. Excess calories from protein can be converted to and stored as fat. Additionally, large quantities of protein strain the liver and the kidneys.

One gram of protein supplies 4 kcal.

Alcohol

Alcoholic beverages (beer, wine, or liquor) are a potent source of energy, but they are not good sources of energy for physical activity or exercise. Obviously, alcohol is not essential, unlike CHO, protein and fat. Also, most people tend to eat junk food when they are drinking. If trying to keep in shape, it is a good idea to minimize the amount of alcohol consumed; it contains little in the way of other nutrients, so replacing a meal with alcohol is not a good idea.

One 12 oz beer is about 150 kcal and one 12 oz "lite" beer is approximately 110 kcal. Wine provides about 90 kcal for every 5 oz, and liquor contains 90 kcal for every 1.5 oz If the liquor is prepared with a carbonated drink, the energy intake will increase by at least 75 more kcal.

One gram of alcohol supplies 7 kcal.

Fueling the Tank

The term "serving" describes the recommended amount of food that should be eaten from each food group. Packaged foods list the number of servings on the Nutrition Facts panel and a serving describes the amount of food recommended in the Food Guide Pyramid and the Dietary Guidelines for Americans. A "portion" is the amount of a specific food chosen to be eaten or served for breakfast, lunch, dinner, or snack. Portions can be bigger or smaller than the recommended food servings. Over the past 20 years, portions have increased substantially, and this has resulted in many people eating more than they should. Larger portions have also contributed to the high incidence of obesity.

CHAPTER 2
WHAT FOOD/BEVERAGES ARE PROVIDED DURING TRAINING

Provided

Meals Ready to Eat (MRE) will be provided for when you do not have access to a Dining Facility. You will be provided 1 MRE for each missed standard meal time: breakfast, lunch and dinner.

- **Entree** - the main course, such as Spaghetti or Beef Stew
- **Side dish** - rice, corn, fruit, or mashed potatoes, etc.
- **Cracker or Bread**
- **Spread** - peanut butter, jelly, or cheese spread
- **Dessert** - cookies or pound cakes
- **Candy** - M&Ms, Skittles, or Tootsie Rolls
- **Beverages** - Gatorade-like drink mixes, cocoa, dairy shakes, coffee, tea
- **Hot sauce or seasoning** - in some MREs
- **Flameless Ration Heater** - to heat up the entree
- **Accessories** - spoon, matches, creamer, sugar, salt, chewing gum, toilet paper, etc.

Each MRE provides an average of 1,250 calories (13% protein, 36% fat, and 51% carbohydrates) and 1/3 of the Military Recommended Daily Allowance of vitamins and minerals. A full day's worth of meals would consist of three MREs.

Gatorade will be provided.

Shopping list

At selection you may be afforded the opportunity to buy certain groceries items. All items must coincide with 24SOW Selection Nutrition handout. Cadre members reserve the right to confiscate any items they feel do not meet the 24SOW Selection Nutrition standards.

Allowable Items:

- Fruits and Vegetable's
- Snack Bars: (Power Bar, Fiber Bar, Granola bar, Etc.)
- Assorted Health Snack's (Nut's, Dried Fruit's, Etc.)

Banned Item's

- Energy drinks of any kind (Monster, 5 hour energy, Etc.)
- Performance Gel's
- Pre/Post Work Out Supplements (C4, N.O Explode, Etc.)
- Protein Bar's Containing Additional Supplements. (Caffeine, Creatine, Etc.)

CHAPTER 3
HOW TO PICK THE RIGHT BEVERAGE

What Conditions Will Increase Water Losses

The primary ways in which you may become dehydrated, or in need of additional body fluids, are by:

- Exercising for over 60 minutes.
- Working in a hot environment—wet or dry.
- Working in a cold environment—wet or dry.
- Going to high altitudes.
- Drinking too much alcohol or caffeine. Click for the caffeine content of various products.
- Exercising in the heat, cold, or at altitude.
- Exercising with a hangover.

Several points about fluids should be considered:

- Do not rely on thirst as a good indicator of fluid needs; body weight losses are better.
- Before any exercise or simulated-mission, fluids should be ingested in anticipation of losing fluid (12–20 oz of cool water before exercise).
- Before starting, urine should be clear or between 1–3 on the chart (unless taking B vitamin supplements)—this is a sign of adequate hydration. The more dehydrated, the darker (and smellier) urine will be (will look like cola).
- Drink regularly or whenever possible during workouts and operations. Drink 16–20 oz of fluid every 20 30 minutes to maintain hydration;
- Weigh yourself before and after an event to determine how much fluid is lost.
- Every one pound of weight lost requires 125–150% more fluid or 20–24oz. It will take about 6 hours to recover from dehydration post exercise/military operation.
- Performance decrements begin when only 2% of body weight has been lost.

The easiest way to restore fluid balance is by drinking fluids that contain sodium. This is very important to remember.

What Should You Drink

Although the type of activity will determine what to drink, the beverage selected should:

- Empty from your stomach and intestines rapidly.
- Taste good.
- Provide CHO when exercise lasts > 1 hr.
- Contain a small amount of sodium (salt).
- Provide no more than 19 grams of CHO per 8 oz.
- Be cool (10 to 15°C).
- Be diluted to ≤ 9 grams CHO/8 oz or a 4–5% CHO solution if fluid needs are > 4L.

Fluid Replacement Beverages

If the exercise is longer than one hour, a beverage that provides CHO should be ingested. Beverages with "glucose polymers" (maltodextrin), or a mixture of glucose and fructose are usually preferable to glucose or sucrose alone. The important message is "drink." A list of beverages, some of which are used as "fluid replacement beverages" by athletes, and a set of criteria for selecting commercial off-the-shelf fluids replacement beverages are presented in Table 3–7. Fluid replacement beverages that contain more than 19 grams of CHO per 8 oz may cause stomach distress and not be absorbed well if consumed before or during physical activity. For example, orange juice should be mixed with an equal amount of water because it is so concentrated.

Criteria for Commercial Off-The-Shelf Fluid Replacement Beverages

- < 95 kcal/8oz.
- CHO Content: 9–19 g/8oz.
- CHO to Protein Ratio: > 4:1 ratio, if any protein/amino acids.
- Sodium: 0.2–1.15 g/L (40-240 mg/8 oz).
- No carbonation.

• No substances other than CHO, electrolytes, and protein.

Table 3–7. Commercial Off-The-Shelf Fluid Replacement Beverages Meeting Criteria				
Products	Energy kcal/8 oz	CHO g/8 oz	CHO:Pro ≥ 4:1	Sodium mg/8oz
CarboPack Beverage	94	19	-	55–160
Cerasport	76	13	-	102
Gatorade Original	50	14	-	110
Gookinade	86	10	-	64
GU2O	50	13	-	120
MetRx ORS	75	19	-	125

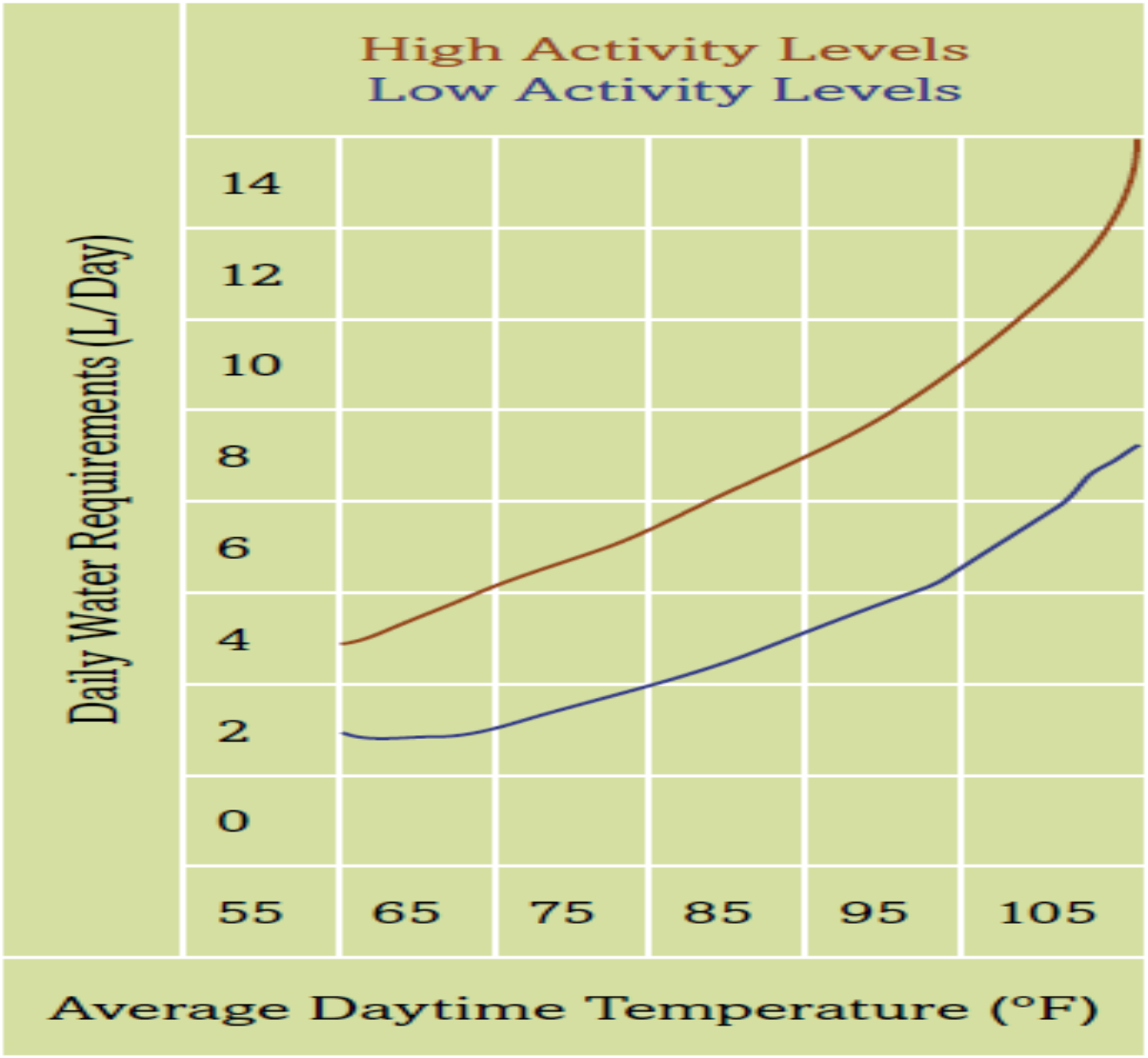
Table 3–7. Commercial Off-The-Shelf Fluid Replacement Beverages Meeting Criteria				
Products	Energy kcal/8 oz	CHO g/8 oz	CHO:Pro ≥ 4:1	Sodium mg/8oz

Powerade	72	19	-	53
Power Bar Endurance Sports Drink	70	17	-	160
Gatorade Endurance	50	14	-	200

When and How Much to Drink

Remember: although the following recommendations are generally sound for most people, everyone is different. Each person must learn to look for signs alerting to his fluid needs. Make adjustments to how warm/hot it is outside. If very hot, make sure to drink fluids with sodium to replace lost electrolytes from sweating. The more physical activity, the more fluid needed! Be careful not to drink too much plain water, especially during

prolonged exercise in the heat. The figure to the right shows daily water requirements as a function of activity and environmental temperature.



"A SOF warrior needs the right nutrition and quantity of food in the same way a high performance car needs the right mixture of high octane fuel and air to achieve peak performance."

CDR Todd L. Tinsley, NSWSBT22

CHAPTER 4
FOUR-DAY INTAKE CHART

Key Points

- Inadequate energy intake and/or dehydration can result in fatigue and impaired performance during combat.
- Improper eating and sleeping due to all night and high op-tempo missions can be detrimental to overall health.
- Eating before night operations should be planned accordingly to prevent fatigue.
- Various environmental exposures (i.e. heat, cold, and altitude) can alter combat effectiveness if nutritional needs and hydration are not met appropriately.
- Energy and fluid requirements are typically higher than normal during combat and combat-simulated scenarios.

The synergistic relationship between adequate fueling and operational performance on the battlefield cannot be underestimated when it comes to mission success. SOF operators, like humvees, black hawks and submarines require high performance fuels to operate effectively. In some instances fueling options are limited, but meeting energy and fluid requirements whenever possible is critical. This chapter describes various fueling options when exposed to various environmental and logistical extremes. As Napoleon Bonaparte stated, "An army marches on its stomach."

Nutritional Readiness Before Missions

SOF must be prepared for deployments at any time. Immediately before such events, SOF may find themselves in the field or under locked down on base. Regardless, the two main nutritional considerations for readiness before missions are:

- Maximizing glycogen stores.
- Being well-hydrated.

Several Days Before a Mission

The average, lean, 175-pound man has approximately 1,800 calories of CHO stored as glycogen in liver and muscle, and 75,000 to 150,000 calories stored as fat or adipose tissue. Despite these large energy stores of fat, CHO is still the preferred fuels, and glycogen depletion will compromise physical and mental performance. Low glycogen stores = fatigue. A diet rich in CHO for several days before a mission will increase liver and muscle glycogen stores, and thereby ensure adequate fuels stores.

Timing and Composition of Pre-Mission Meals

The purpose of the pre-mission meal is to ensure adequate glycogen stores and maintain blood sugar. Every SOF should know his own tolerance for timing of meals and what patterns are needed to sustain performance. In general, intense physical activities demand a longer time period after meal ingestion to allow for digestion and minimize gastrointestinal distress.

Eat 2–4 grams of CHO per pound body weight, but no more than 400 grams, 3–4 hours before a sustained operation.

A pre-mission meal should provide a minimum of fat, since it takes longer to digest than CHO. CHO beverages and CHO/protein drinks are excellent choices if taken four hours before the start of a mission. Liquids are digested and absorbed more rapidly than solids, but personal choice is important. Avoid a high protein meal because it is harder to digest than CHO, and is not a readily available source of energy.

CHO Intake

As noted earlier, a high CHO diet is needed to maintain muscle glycogen stores and blood glucose. A diet that provides 50 to 70% of energy from CHO, 10 to 20% from protein and 20 to 35% of calories from fat is important for SUSOPS. High CHO snacks and/or CHO-containing fluid replacement beverages providing 15–30 g of CHO/hour will also help to maintain blood glucose and delay fatigue during strenuous prolonged missions. When blood glucose levels fall, hypoglycemia results causing performance to drop rapidly, and you will be incapable to continue the workload you initially started at.

Hydration Status

Since water is critical for maintaining optimal operational performance as well as maintaining good general health, proper daily water intake is one of the most important factors for operators. In 2004, the Institute of Medicine updated the adequate intake (AI) for water to 3.7 liters, or nearly one gallon of water, per day for men over the age of 19. Individuals typically need 1 milliliter of water for every kcal consumed. SOF operators usually have fluid needs greater than the recommended because of intense training, working in high humidity, extreme temperatures and austere environments.

When possible, select fluids that contribute not only fluids, but also vitamins and minerals.

Fluid balance can be maintained with beverages containing water, such as juice, milk, coffee, tea, soda, and foods. Fruits and vegetables contain an upwards of 70%–90% water, whereas meats, dairy products and grain products consist of 30%–50%.

Beverages consumed in the heat should be no more than 8% CHO—or less than 19 grams/8 oz.

The need for electrolyte replacement in the field may be very great under warm and hot weather conditions, and during military exercises involving high mobility and strenuous physical work lasting 60 minutes or longer. When water is the only fluid available, the electrolyte SportStrips, a new product on the market, may be very useful. The SportStrips, which provide sodium and potassium, are inserted into the mouth between the gums and cheek and should be absorbed very quickly. The gastrointestinal tract is not required for absorption and as such, may be important for other conditions, such as dehydration from diarrhea. The effectiveness of this product is under review, but appears promising for military applications because of its simplicity and ease of transporting.

Dehydration can result in a loss of appetite.

Fluid replacement beverages with CHO are suggested during extended missions; however, the amount of CHO should be lower than usual so that the fluid/water is rapidly absorbed.

Caffeine Intake

It is well-recognized that caffeine increases alertness and may delay fatigue during extended operations. However, the effective dose may vary, depending on habitual caffeine intake and sensitivity to caffeine. Caffeine is less effective for those who routinely consume large amounts. For caffeine to be effective, it should be consumed on an irregular basis.

A common dose shown to be effective for maintaining performance and vigilance is 200 mg. Although less may also be effective, the military has prepared “Stay Alert” gum, which contains 100 mg per chicklet. The current recommendation is to take 200 mg every two hours, for up to eight hours straight to help with alertness during operations. A regular dosing is needed because the effects of caffeine typically wear off within six hours.

Caffeine-rich beverages and foods are among the most popular forms of nutrition to help operator’s maintain alertness at night. However, most products containing caffeine do not list amounts of caffeine on Nutrition Facts Labels. Manufacturers are not required to list caffeine amounts on labels, so the consumer can only determine the caffeine content by recognizing caffeine effects.

Nutritional Readiness During Missions

Four major nutrition-related issues encountered in the field are:

- Inadequate ration consumption.
- Inadequate energy intake.
- Dehydration.
- Gastrointestinal complaints.

Rations

One of the biggest problems with eating rations is that it gets boring! Monotony and lack of time to eat contribute to decreased ration intake and weight loss. Therefore, it is important to consume as much of the field ration as possible to maintain performance and health.

Limit use of non-issue food items as meal/ration substitutes since they may be lacking in several important nutrients. Use these items as snacks to supplement daily rations. Also pack high CHO items, such as crackers, dried fruits, trail mixes, sports bars, and like (see Chapter 8 for snack ideas). Experiment beforehand to see what suits you best. When planning to use high CHO bars, check the fat content, because if the fat content is greater than 3 g/100 calories it may slow down absorption and can cause cramps.

The new First Strike Ration, which provides an average of 2,900 kcal per day, is great for missions, except that additional CHO must be provided to meet CHO needs. Table 3 provides the content of the three menus. This new ration takes up less space and weighs approximately 50% less than three MREs.

Dehydration

Dehydration occurs when sweat and urine losses are not replaced by drinking water and other fluid replacement products. It can occur at altitude, in the cold, in the heat, during diving, and even under conditions of low physical activity. Mild dehydration can decrease appetite and cause lethargy. It should be avoided at all costs. Water and other fluids should be consumed when thirsty. At least 4 L should be consumed each day—more when the environment is hot.

Gastrointestinal Complaints

Changes in diet, dehydration, too much fiber, poor sanitary conditions, contaminated food, unfamiliar bacteria, and/or stress may result in diarrhea or constipation in the field. Ensure adequate hydration at all times, and avoid new non-issue foods whenever possible.

Missions in the Heat

Repetitive movement along difficult terrain with heavy gear, such as during land warfare operations, is strenuous under any environmental condition, but particularly arduous with extreme heat and humidity. Land warfare scenarios where operators carry heavy loads or injured comrades increase overall effort and energy expenditure, as well as fluid and electrolyte needs. The major concerns during operations in a warm/ hot environment are fluid and electrolyte balance. Working or exercising in the heat exacerbates water and electrolyte loss through sweating. The amount of sweat and fluid lost depends on:

- Environmental temperature and humidity.
- Work rate.
- Fitness level and acclimatization.
- Volume and rate of fluid replacement.

When the same task carried out in thermoneutral environment is performed in a hot environment, energy requirements are slightly increased due to the increased work of maintaining thermal balance. When living/working in temperatures ranging from 86 to 104° F (30 to 40° C), energy intakes typically increase by 10%, unless activity level decreases accordingly.

Tip: If activity levels decrease, no extra energy is needed!

High work rates in hot, humid surroundings can significantly increase fluid and electrolyte losses. Losses of one to two quarts per hour or even more are likely when special clothing, such as chemical protective gear, and/or body armor is worn. The highest sweat rates reported are over five quarts per hour. That is a lot of fluid.

Fluids—Drink Early and Drink Often

Starting any operation without being adequately hydrated may increase the risk of performance mishaps. Some believe that relying on thirst is adequate for sustaining hydration, whereas others believe that thirst itself is an indicator of dehydration. For certain, failure to replace lost fluids from sweating will result in dehydration and possibly heat injury. Always drink when thirsty.

Although forced drinking is recommended throughout training in a warm environment to ensure adequate fluid replacement and performance, this is not always wise. Too much water can result in hyponatremia. A predetermined drinking schedule is recommended to ensure enough fluids are being consumed: some type of beverage should be consumed with all meals and snacks.

Drink 1–2 cups of fluid every 30 minutes.

Drinking more than 4 cups per 60minutes may be *too much* to absorb!

In the field when it is difficult, if not impossible, to obtain a body weight, urine color should be used to gauge hydration status.

One pound of weight lost requires 2.25 cups or 0.5 quarts of fluid to restore fluid balance.

A fluid loss of 2% body weight can impair physical performance and mood, decrease appetite, and increase the risk of heat injuries. A 5% loss of body weight can decrease work performance by 30%. This amount of water loss is a serious threat to overall health.

Monitoring Hydration in the Field

Monitor hydration status by inspecting urine color. Dark yellow or smelly urine suggests some degree of dehydration; fluid consumption should be increased until urine becomes pale yellow. If taking B vitamins, urine may be bright yellow, not pale, regardless of hydration status.

Electrolyte Balance

Excessive loss of electrolytes (i.e., sodium, potassium) from sweating can lead to muscle cramping or severe medical problems. Being in excellent physical condition will help minimize electrolyte losses, but athletes given free access to water when exercising in the heat replace only one half to two thirds of their fluid losses. Also, camelbacks are routinely used to stay hydrated, but since they provide water alone, electrolyte balance may be compromised. To maintain electrolyte snacks that contain sodium and potassium, fluids with electrolytes, electrolyte SportStrips or electrolytes in the form of gels and blocks may be needed during and after missions. Electrolytes should offset hyponatremia.

Fluids alone may not be adequate for restoring or maintaining electrolyte balance, because there is an upper limit to how much sodium and potassium should be provided in a beverage.

Check labels to ensure that beverages provide no more than indicated in the chart above. The National Academy of Sciences recommends that chloride be the only "anion" (negatively charged electrolyte) accompanying sodium and potassium, and no other electrolytes are recommended. Typically, magnesium and calcium are included, but the amounts are well below recommended upper limits.

In addition, foods that naturally provide sodium and potassium should be selected. Dried fruits are optimal food choices for potassium. For example, a small box of raisins provides 322 mg of potassium. Even if heat acclimatization has occurred, it is important to understand the importance of salt: 200–400 milligrams of sodium can be lost per pound of sweat, along with sodium excreted in urine. Adding salt to foods (1/2 teaspoon provides 1,200 milligrams) or including sodium-rich foods in the diet will help retain water and avoid a sodium deficit. Sodium is the most critical electrolyte for maintaining fluid balance.

Missions in the Cold

Exposure to a cold environment seriously challenges the human body. Blood vessels tighten to conserve heat and shivering is initiated to gener163 ate heat and guard against hypothermia (a dangerously low core body temperature). Side effects of these responses are: an increase in urine output and an increase in energy metabolism. Therefore, the most important nutritional considerations for a cold environment are:

- Energy intake.
- Glycogen stores.
- Fluid status.
- Vitamin and mineral needs.

Energy Intake

Energy requirements can increase 25–50% during cold weather operations as compared to warm weather operations.

Cold weather increases energy requirements significantly. Factors that increase caloric intake include:

- Added exertion due to wearing heavy gear.
- Shivering, which can increase resting metabolic rate by two to four times the normal level.

- Increased activity associated with traveling over snow and icy terrain.
- Increased activity to keep warm.

Many studies have shown that warfighters tend to progressively lose weight when conducting two to three week field exercises in the cold. Because significant weight loss can result in fatigue and performance decrements, energy intake should meet the increased energy demands.

Energy expenditure for soldiers during periods of physical exertion in the cold may range between 4,200 and 5,000 kcal/day. Although CHO is critical, a diet that provides 35% of the energy as fat may be necessary to match energy needs. It is important to remember that both fat and CHO are important energy sources in a cold environment.

Ideally, during cold weather operations, 50–60% of energy should come from CHO, 30–35% from fat, and 10–20% from protein: high CHO snacks should be eaten between meals. A high protein diet is not advised as it may increase fluid requirements.

Missions in cold weather require foods that produce heat. Foods high in CHO produce more heat through digestion than either fat or protein. Hot beverages, such as cocoa, provide CHO and other warm beverages, to include coffee, teas and broth, increase body temperature, enhance mental awareness and provide comfort.

Eat high CHO snacks frequently.

Glycogen Stores

Prior to deploying to a cold environment, the pre-mission diet should ensure that glycogen stores are optimized. Likewise, a high CHO diet is preferred during cold exposure, as CHO are needed to replenish glycogen being used to maintain core temperature. Thus, regular meals and snacks providing CHO should be eaten to maintain CHO intake. Including a liquid or solid CHO supplement may be critical for maintaining energy balance and performance.

A minimum of 400 grams of CHO is necessary in the cold.

Fluid Status

Becoming dehydrated in cold environments is easy because of the cold induced increase in urine output, increased fluid losses through breathing, involuntary reduction in fluid intake, and sweating. Because dehydration decreases performance and potentially may lead to various medical problems, maintaining fluid status by drinking plenty of fluids and monitoring hydration is absolutely critical.

Force yourself to drink 2–4 cups of warm fluid at hourly intervals. Avoid alcoholic beverages: alcohol tends to increase heat and urine losses. Drink beverages with CHO to increase energy intake. Don't eat snow without first melting and purifying it. Moderate caffeine consumption.

Beverages containing 5–8% CHO and some electrolytes are best. Drinking 1 to 2 cups per 30 minutes is recommended.

Vitamin and Mineral Needs

The requirements for some vitamins and minerals increase when working in the cold due to increases in energy metabolism (example: thiamin) or urinary losses (example: magnesium, zinc). The amount by which daily vitamin and mineral needs may increase above the DRI during cold weather operations are shown in Table 8. These amounts are based on intake data from field studies, urinary excretion of nutrients and other measures of "nutrient status." In most cases, energy requirements and vitamin and mineral needs can be met by eating all ration components.

Missions at Altitude

Ascent to altitude and flying can cause a variety of disturbances, and adequate nutrition is crucial for maintaining performance. The major nutritional concerns at altitude are:

- Weight loss.
- CHO intake.
- Dehydration.
- Oxidative stress.

Weight Loss

Virtually all people who go to high altitudes experience weight loss and loss of lean body mass. At altitudes below 5,000 m weight loss can be prevented by being vigilant about eating on a regular basis. Above 5,000 m, a 5–10% weight loss is inevitable. Energy intakes should range from 3,500–6,000 kcal per day, which is equivalent to eating at least four MREs or two First Strike Rations daily. Some reasons for weight loss at altitude include:

- Increased energy requirements to 115–150% of sea level requirements.
- Decreased sense of taste, which causes a reduction in food intake.
- Changes in the metabolism of fat and CHO.
- Loss of body water from increased breathing rate and dry air.
- Impaired absorption of nutrients.
- Acute Mountain Sickness (AMS), which can cause nausea, vomiting, headache and decreased appetite.

The only way to minimize weight loss is by being vigilant about maintaining energy intake.

Energy requirements may increase 15–50% above requirements at sea level.

CHO Intake

High CHO foods are the preferred energy source at altitude and in flight because they:

- Replete glycogen stores.
- Require less oxygen to produce energy than fat.
- Are the most efficient energy source.
- Can blunt and delay the progression or severity of AMS symptoms (nausea, vomiting, and headache).
- Maintain blood glucose.

Diets should provide at least 400 grams of CHO and CHO should contribute 50–70% of the total energy. This can be accomplished by eating high CHO snacks between meals and drinking CHO-containing beverages during strenuous activity, long flights, and recovery.

Dehydration

Dehydration in a plane is different from on a mountain.

Exposure to high altitude is associated with significant levels of dehydration because water losses are increased. If these losses are not replaced, dehydration will result. Some studies suggest that vigorous hydration may decrease the incidence and severity of AMS. Dehydration will increase the risk of cold injury. The reasons dehydration occurs at altitude include:

- Increased respiratory losses due to increased ventilation.
- Increased urine output due to altitude and cold temperatures.
- Possible diarrheal fluid losses.
- Failure to drink water.
- Poor access to water.

Pilots need to have regular access to a bottle of water or an electrolyte beverage, but on a limited basis. Drinking beverages with sugar is not recommended. Also, coffee, sodas, and teas should be avoided. Importantly, do not over-exercise before a flight, since strenuous exercise can deplete body water, which may be difficult to replace quickly. Recent illness, fever, diarrhea, or vomiting will also greatly affect the degree of dehydration.

Fluid requirements may be > 4 quarts per day at high altitude. Maintain a drinking schedule and monitor hydration status daily to avoid AMS.

Oxidative Stress

One consequence of altitude exposure is the production of an excessive load of reactive oxygen species. In particular, increased metabolic rate and hypoxic conditions at altitude can increase the production of harmful free radicals. Collective free radicals cause oxidative stress, which may slow blood circulation and impair physical performance. Polyunsaturated fatty acids (PUFAs) are the nutrients most susceptible to oxidative stress. Studies have shown that symptoms of altitude sickness correlate with markers of oxidative stress. Thus, antioxidants have been used to minimize oxidative stress.

Several studies indicate that taking Vitamin E (400 IU/day) may reduce free radical production at altitude, and help maintain blood flow and aerobic energy metabolism in men. Also, a combination of antioxidants (1,000 mg of Vitamin C, 400 IU of d,l-tocopherol acetate and 600 mg of alpha-lipoic acid) taken in divided doses in the morning and evening was shown to minimize symptoms of altitude sickness and improve energy intake in men.

Although studies are showing benefits of antioxidants, too much may be harmful. Exposure to altitude produces natural adaptations and it is possible that too much of any antioxidant could compromise nature's response to lower oxygen levels.

Missions in Water and at Depth

Like exposure to altitude and cold environments, water operations, especially cold water operations, are associated with increased energy expenditure and marked fluid losses. Thus nutritional concerns for diving are maintaining:

- Energy intake.
- Fluid intake.
- Mineral balance.
- Antioxidant balance.

Energy Intake

When working at the same rate in water as on land, the energy expenditure to accomplish the same task is greater in water. The reasons for this increased energy expenditure during water operations include:

- Greater resistance offered by water.
- Decreased efficiency of movement when thermal protective clothing is worn.

Glycogen stores are rapidly used when performing hard work in cold water. These stores must be replaced between operations to prevent performance decrements. Increasing CHO intake before an anticipated dive has been shown to improve and extend exercise performance during prolonged dives.

Fluid Intake

Immersion in water increases urinary excretion by 2–10 times above normal. Without adequate hydration a diver can quickly become dehydrated and suffer performance decrements. For example, immersion during a single dive for 3 to 6 hours can result in a 2–8 pound loss in body weight by urination; this is equivalent to losing 1–3 quarts of fluid. Importantly, drink fluids with CHO whenever possible to maintain blood glucose. A decline in blood glucose is known to adversely affect performance.

Mineral Balance

Immersion in water, especially cold water, increases urinary losses of magnesium, calcium, zinc, and chromium. It is important to consume foods high in these important minerals to restore immersion-induced losses.

Antioxidant Balance

Like altitude, diving results in greater oxidative stress than working at sea level. This makes sense because with increased depth comes increases in oxygen tension. Oxidative stress is even greater when oxygen is the air breathed at depth. As noted with altitude, some adaptation takes place and natural antioxidant defense systems are "up-regulated" to minimize cell damage from oxidative stress. Despite this, antioxidants have been used to combat potential deleterious effects of oxidative stress. Although no definitive recommendations can be made, some benefits have been noted by taking 1 gram of vitamin C and 400 IU of vitamin E two hours before extended dives. However, a diet high in natural antioxidants should confer protection as well.

Diving at depth, especially when breathing oxygen-rich gas, facilitates the formation of "reactive" oxygen species.

Mission Scenarios

Nutrition challenges are expected during deployments where harsh environmental conditions, austere living quarters, and lack of food services are the rule. Although nutritional inadequacies can compromise performance, if energy intake can be maintained above 2,000 kcal/day with at least 300 gram of CHO and 60 gram of protein, and fluid status maintained, performance should be sustained over a period of weeks. However, developing sound nutritional plans for training and mission scenarios should help sustain performance. Sample nutrition plans are provided for the following training scenarios:

- Typical Training Day.

- SDV Operation.
- Unconventional Warfare.
- Special Reconnaissance.
- Nighttime Air Mission.

For most scenarios, the macronutrient recommendations assume an energy requirement of 4,000 kcal/day. If energy requirements are lower or higher, the amounts of CHO, protein, and fat should be altered accordingly. The timing and/or amount of any particular nutrient can be modified to suit individual needs based on the scenario and personal experiences. Snacks refer to food and beverages that can be carried and consumed while on the mission/operation. Specific foods are not identified, but a list of good field foods, both from rations and commercial off-the-shelf products is included. Each person has individual tastes and it is most important that all food components taken for deployment be tested. The caveat is for extended missions when eating on the economy is the rule, rather than the exception.

CHAPTER 5
HIGH PERFORMANCE CATALYSTS/ANTI-CATALYSTS

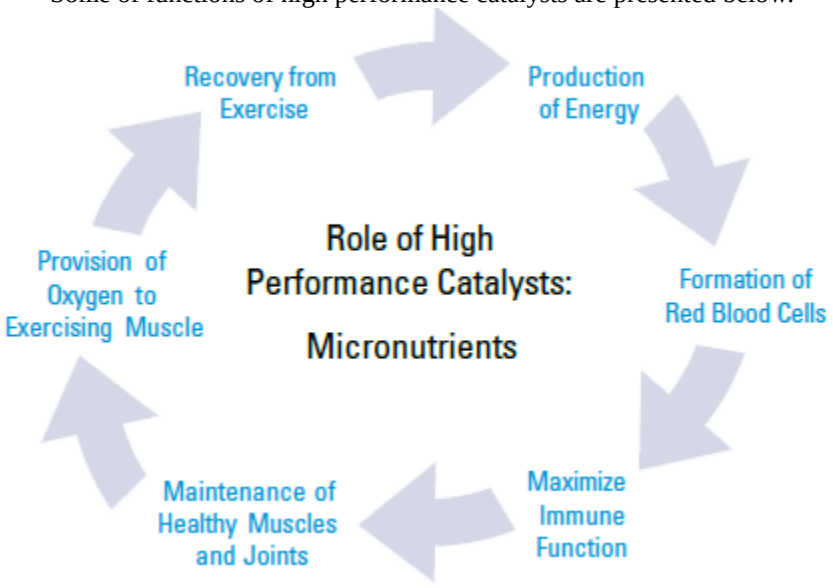
Key Points

- Vitamin and mineral needs can be met by eating a variety of foods.
- Vitamin-mineral supplements do not provide energy.
- Vitamin-mineral supplementation is warranted only when energy balance is not met through the diet.
- Mega-dosing on vitamins and minerals can be detrimental to health and performance.
- Foods naturally high in antioxidants (fresh and colorful foods) should be eaten daily.

High performance catalysts, or micronutrients, allow performance at a high level. Catalysts include vitamins, minerals, and other essential nutrients required by the body in very small amounts to perform vital metabolic and physiologic functions. Taking in too little or too much of these nutrients can interfere with normal body functions.

Role of High Performance Catalysts in SOF

Some of functions of high performance catalysts are presented below.



Different amounts of catalysts are needed by individuals, depending on gender, age, activity, and environment. The best way to obtain the required amounts is to eat well-balanced meals with foods that are nutrient dense. A daily diet of diverse foods can provide the necessary amounts of high performance catalysts for a well-tuned body.

If energy intake is sufficient, the high catalyst requirements of SOF warriors should be adequate.

Dietary Reference Intakes and Definitions

Various terms have been developed to explain how much of these "catalysts" are needed. The term Dietary Reference Intakes (DRI's) refers to the amount of particular vitamins and minerals a typical person should eat to prevent a deficiency. The DRIs also have a Tolerable Upper Intake Level (ULs) that tells us how much is *too* much. The term % Daily Value (DV) on a food label represents how much one serving contributes nutritionally to a 2,000-calorie-a-day diet. If the label says 15% DV for Vitamin C, then one serving provides 15% of the DRI for Vitamin C. Other terms and definitions are noted on the side bar. The U.S. Military also has Military Dietary Reference Intakes (MDRIs) based on the U.S. DRIs. They are for planning, assessing diets, and developing rations for the military population. Neither DRIs nor MDRIs consider the nutrient needs of SOF warriors, who train and operate under diverse, often grueling, environmental conditions.

Nutrient Density

The term "nutrient density" is important to understand. It is the amount of a particular nutrient (vitamin, mineral, carbohydrate, protein, fat, etc.) per unit of energy in a given food, or per gram of food. It is also an index of nutritional quality. In the following table, Comparison 1 shows the nutrient density of the food label for granola versus glazed donuts. Comparison 2 shows the information for orange juice versus coca cola. The granola and orange juice are clearly more "nutrient dense" than their comparative foods.

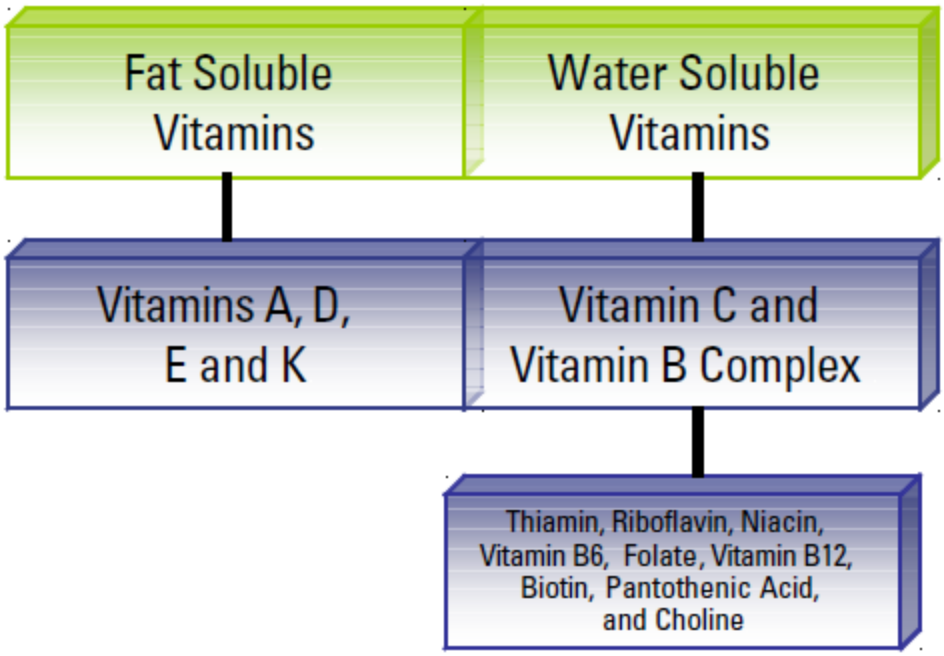
Table 4–1. Examples and Comparisons of Nutrient Density

Comparison 1		Comparison 2	
Kashi Go Lean Crunch (1 oz)	Glazed Donut (1 oz)	Orange Juice (100 ml)	Coca Cola (100 ml)
0% DV for Vitamin A	0% DV for Vitamin A	4% DV for Vitamin A	0% DV for Vitamin A
3% DV for Calcium	1% DV for Calcium	1% DV for Calcium	0% DV for Calcium
0% DV for Vitamin C	0% DV for Vitamin C	83% DV for Vitamin C	0% DV for Vitamin C
5% DV for Iron	3% DV for Iron	1% DV for Iron	0% DV for Iron
20 g Fiber	0 g Fiber	0 g Fiber	0 g Fiber
10 g Protein	1 g Protein	1 g Protein	0 g Protein

Many other examples could be presented, but clearly foods with more fiber, "high performance catalysts," and less fat and simple sugars should be selected. At least 90% of the diet should be comprised of nutrient dense foods.

Vitamins

Vitamins are organic compounds that allow for energy to be produced, among other functions. They are broadly classified as water- and fat-soluble: water-soluble vitamins dissolve in water and are not stored, but rather eliminated through urine; therefore, a continuous supply is needed in the diet. However, fat soluble vitamins are not required every day because they are stored in fat tissue and the liver. Fat-soluble vitamins are best absorbed with dietary fat. Choline is another essential nutrient and similar to the B-vitamins, but not officially listed as a B-vitamin.



Functions of Vitamins

- Production of energy from macronutrients (CHO, fats, and proteins).
- Repair and growth of tissue.
- Maintenance and support of reproductive function.
- Development of immune response.

Some functions may be specific to only one vitamin, whereas other functions may require more than one vitamin. For example, several B vitamins and some minerals are required to produce energy from foods.

Good Food Sources of Vitamins

No single food is a good source of all vitamins, which is why it is important to eat a variety of foods. Some processed foods provide many vitamins because they have been fortified with nutrients, whereas other foods may contain few, if any, vitamins. When eating at home or dining away from home, the key to eating a balanced meal is choosing a variety of foods, whenever possible. To obtain the necessary vitamins, a dinner plate should include:

- A heaping pile of vegetables (excluding potatoes and corn).
- Black, pinto, or kidney beans and whole grains or corn.
- Fish, lean poultry, or lean cuts of red meat, tofu, dairy products.
- Nuts/seeds.

If eating field rations during training or deployment, eat the entrees as well as the other food and beverage items provided in the pack since different food/beverage items are fortified with different micronutrients. For example, cocoa in the Meal Ready to Eat ration is a source of vitamin B1, calcium and magnesium.

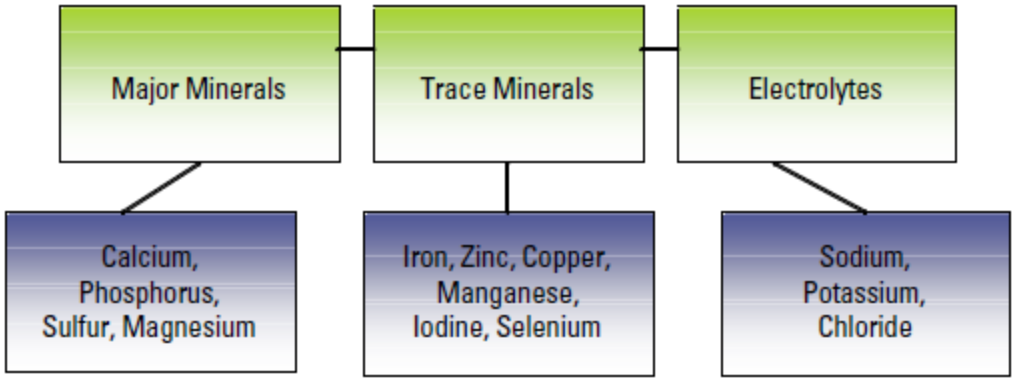
Preserving Vitamins in Foods

Proper food storage and preparation can minimize vitamin losses. All vitamins are destroyed by light and many are destroyed by excessive heat. Water-soluble vitamins are easily washed out when foods are over-cooked. Steps that should be taken to increase the retention of vitamins during storage and preparation include:

- Keep foods out of direct light as much as possible, especially milk and grains.
- Keep fresh produce refrigerated.
- Avoid soaking vegetables in water.
- Cook in just enough water to prevent burning.
- Use the shortest cooking time by cooking to a crisp and tender stage.
- Steaming and stir frying result in the best vitamin retention.

• Cut and cook vegetables shortly before serving or refrigerate in an airtight storage container.

Minerals



Minerals are inorganic substances that can be single elements, such as magnesium (Mg) and calcium (Ca), simple salts (electrolytes), or metals, such as iron (Fe). Numerous minerals are required by the body, and may account for 4–5% of a person's body weight. Typically, minerals are classified as major minerals, trace minerals, or electrolytes, depending on function and how much is in the body.

Major minerals are required in relatively large amounts (> 200 mg/day), whereas trace minerals are required in smaller amounts (< 200 mg/day). They can occur naturally in food or be added in elemental or mineral form. Appropriate dietary intakes of minerals must be sustained to maintain physical health. Excessive intakes may lead to adverse consequences because of the competitive nature between minerals in the body. For example, zinc and copper, and calcium and magnesium are needed in particular ratios. Electrolytes include sodium, potassium, and chloride.

Functions of Minerals

- Brain and neural function.
- Bone structure and maintenance.
- Muscle function and growth.
- Production of energy.
- Reproductive functions.
- Immune function.

Good Food Sources of Minerals

As with vitamins, a variety of foods should be eaten in order to meet requirements for these essential nutrients. Table 4–2 provides a list of foods that are high in selected minerals.

Table 4–2. Primary Food Sources for Some Minerals

Food Products	Major Mineral
Green leafy vegetables and dairy products	Calcium
Nuts, soy beans, and cocoa	Magnesium
Milk and spinach	Sodium
Legumes, whole grains, and bananas	Potassium
Table salt	Chloride, iodine
Meat, eggs, and legumes	Sulfur
Red meat, poultry and seafood	Zinc
Red meat and leafy vegetables	Iron

Mineral Requirements for Military Garrison Training

The MDRIs reflect the Institute of Medicine (IOM) Dietary Reference Intakes (DRIs). Modifications to these requirements should only be made when sufficient scientific evidence exists to support different requirements and intakes. The recommended values for some minerals should take into account enhanced mineral losses caused by high-performance activities. Evidence strongly indicates that sweat mineral losses of copper, iron and zinc might be significant during garrison training. New recommendations reflect this evidence (See Table 4–3). However, insufficient data exists for sweat losses of calcium, magnesium and selenium to recommend an increased in26 take. Also, requirements might be different for specific military situations and more research is required prior to changing current recommendations.

Table 4–3. Mineral Intakes for Men: Institute of Medicine Dietary Reference Intakes, Current Military Dietary Reference Intakes, and Recommended Levels for Military Garrison Training and Assault Rations

Nutrient	IOM RDA or AI*	MDRI	RDA of AI for MGT	RDA for Assault Rations*
Calcium (mg)	1,000	1,000	1,000	750–850
Copper (µg)	900	ND	1,800	900–1,600
Iron (mg)	8	10	14	8–18
Magnesium (mg)	420	420	420	400–550
Selenium (µg)	55	55	55	55–230
Zinc (mg)	11	15	15	11–25

Note: Institute of Medicine = IOM; RDA= Recommended Dietary Allowance; AI=Adequate Intake; MDRI = Military Dietary Reference Intakes; MGT= Military Garrison Training; ND= Not Determined; *Institute of Medicine (2006).

Special Catalysts: Antioxidants

Antioxidants are substances in foods that neutralize highly reactive, destructive compounds called free radicals. Note the following key points about free radicals and antioxidants:

- Free radical damage can lead to cancer and heart disease.
- Free radicals from harmful pollutants are neutralized by antioxidants.
- Foods rich in antioxidants are the best source of antioxidants.
- Smokers should consume foods high in antioxidants.

Some well-known antioxidants include:

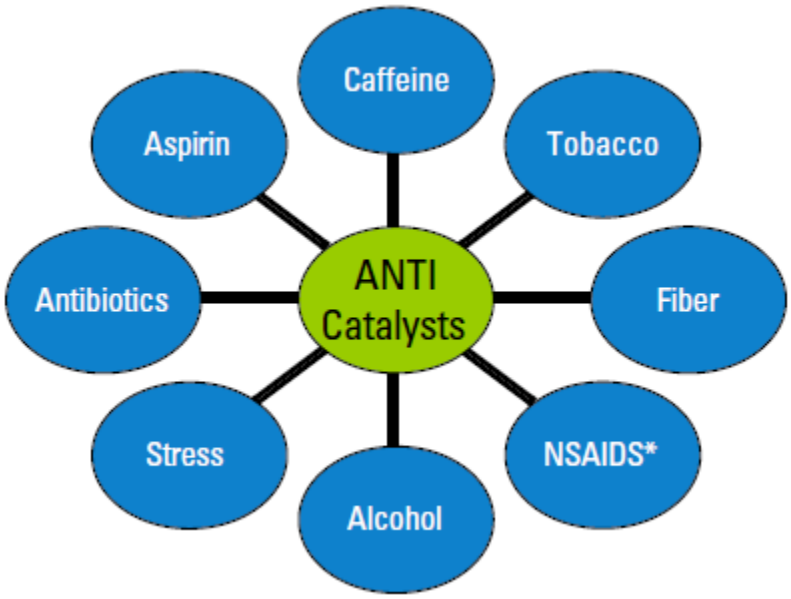
- Vitamin E.
- Selenium.
- Beta Carotene.
- Glutathione.
- Cysteine.
- Flavonoids.
- Vitamin C.
- Glutathione.

Some critical antioxidants are enzymes, such as superoxide dismutase,and catalase.

Antioxidants should come from food.

Substances That Interfere With High Performance Catalysts

Many substances affect both the absorption and loss of high performance catalysts. For example, the amount absorbed from foods can be influenced by dietary constituents (such as fiber), other factors (such as medications), the body's need for the nutrient, the chemical form of the nutrient, and the integrity of the digestive tract. "ANTI-catalysts" that can interfere with how well the body uses nutrients are shown below:



To minimize the potential effects of ANTI-catalysts, one should:

- Eat a variety of foods.
- Use good food preparation techniques.

Vitamin and Mineral Dietary Supplements

The DRI for high performance catalysts provide a wide safety margin, but some adjustments may be required in individuals with very high energy expenditures. Nutrient requirements for antioxidant vitamins (C, E and carotenoids), B vitamins, magnesium, zinc, copper, selenium and iron needs may be slightly higher in SOF warriors because of activity levels. But, a good, varied diet will allow the DRI to be met. Despite this, the supplement industry encourages physically active people to purchase vitamin and mineral supplements to enhance performance. About 40–80% of military personnel use some form of vitamin and/or mineral supplements. These include single vitamins (vitamin C), minerals (calcium) and/or multivitamin-mineral combinations. In many cases the doses range from amounts similar to or far in excess of the DRI. Vitamin and mineral supplements are useful when:

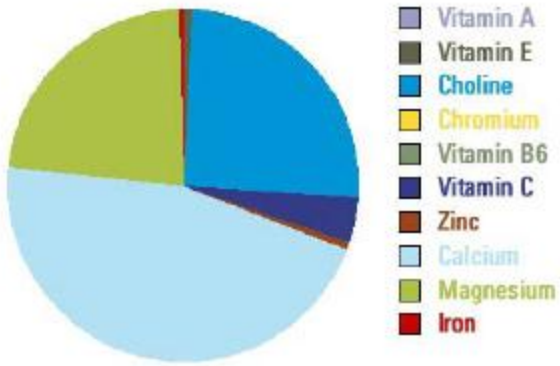
- An existing vitamin or mineral deficiency is present.
- Individuals have poor nutrient intakes and dietary habits.
- Energy requirements cannot be met by food.
- Individuals are exposed to extreme environments, such as strenuous exercise, cold exposure, and at high altitude.

Vitamin and Mineral Supplement Use and Performance

Taking a general multivitamin/mineral supplement appears to be without measurable performance benefit in healthy, well-nourished, physically active men. Whether supplementation with such nutrients produces beneficial effects on performance in SOF warriors is unknown. For example, supplementation with selected vitamins/minerals may accelerate recovery or reduce susceptibility to infections. Some information to confirm these possibilities is available, but studies have not been conducted in military populations. If a vitamin and/or mineral supplement is desired, the supplement should provide nutrients in amounts that meet the DRI, and no supplement should provide more than the Upper Limit as indicated by the National Academy of Sciences.

The illustration below presents the relative amounts of "popular" vitamin and minerals needed on a daily basis.

Relative Daily Intake of Vitamins and Minerals (mg/d)



Risks of Vitamin and Mineral Supplements

Excessive intakes of some vitamin and mineral supplements can cause multiple side effects, and some vitamins and minerals can be toxic. Although some people take excessive amounts of nutrients on a regular basis, it is important to distinguish between excessive and toxic. Excessive amounts of single or multiple nutrient supplements can upset overall nutrient balance and cause a deficiency of other nutrients. Iron, zinc and copper are good examples, since all three are absorbed via the same route. An excessive intake of zinc can prevent the proper absorption of the others. Additionally, excess vitamin E (in the form of alpha tocopherol) has been shown to slow healing, inhibit the immune system, and increase the risk of bleeding. Symptoms may include fatigue, weakness, headache, blurred vision, and diarrhea. Other fat-soluble vitamins, such as vitamin A and D, can also be taken in excess. Vitamin C overdoses are unlikely, but taking a lot of vitamin C followed by low levels can lead to "rebound scurvy." Importantly, intakes above DRI upper limits may have significant adverse effects. Table 4–4 provides a list of various nutrients and levels considered to be toxic.

Table 4–4. Nutrients and Their Toxicity Values

Nutrient	Toxicity (units/day)	Nutrient	Toxicity (units/day)
Vitamin A	>25,000 IU	Magnesium	>6,000 mg
Beta Carotene	None	Boron	>100 mg
Vitamin D	>50,000 IU	Chromium	>10 mg
Vitamin E	>1,200 IU	Copper	>35 mg
Vitamin B6	>2,000 mg	Iron	>100 mg
Vitamin C	Rare	Selenium	>1 mg
Calcium	>2,500 mg	Zinc	>150 mg

To avoid harmful effects from high doses of supplemental vitamins and minerals, refer to the DRI upper limits. Vitamin and mineral supplements are absorbed best when taken with food.

Do not take a vitamin/mineral supplement with a carbohydrate-protein drink that already contains vitamins and minerals or the supplement and money will be wasted: excess amounts are excreted in the urine.

CHAPTER 6
TIMING OF REFUELING

Key Points

- The timing of nutrient delivery is critical to sustaining performance.
- The Refueling Interval (RFI) is the 45 minutes after finishing a workout.
- Eating during the RFI will accelerate recovery and restore energy for the next day's workout.
- A daily diet that is balanced and nutrient-dense will ensure better performance and optimal recovery.
- CHO foods and beverages that have a moderate to high glycemic index, such as sport drinks, raisins, honey, bananas or potatoes are ideal recovery foods.
- Adding protein to the recovery meal will help stimulate protein synthesis to assist in rebuilding muscle (anabolism).
- For exercise longer than 90 minutes, consume 50 grams of CHO and 12 grams of protein as food or drink immediately during the RFI and 50 grams of CHO every 2 hours for 6 hours.
- Adequate fluids must be ingested after a mission.
- Fluid replacement beverages should contain sodium and potassium.
- Sports bars, gels and drinks are lightweight, portable and easy to eat during SOF operations.

The goals of training are to promote changes in the body such that muscular strength, aerobic capacity, and endurance are optimized. Training goals cannot be achieved in the absence of appropriate nutritional strategies. Before and after training or missions, strategies to ensure adequate energy stores and rapid recovery for the next mission are critical. Well-conceived meal and snack plans will enhance preparedness, boost morale, stimulate muscle protein synthesis, and help protect against training injuries. Nutrient timing combined with rest is essential. This chapter will provide information about nutritional strategies to optimize training in preparation for missions.

Everyday Nutrition and the "ine" Diet

For performance and recovery to be optimal, the everyday diet of SOF members must be as good as it possibly can be. Routine dietary habits must be considered to determine what should be done to ensure operational performance and overall good health. The usual CPF (CHO: Protein:Fat) pattern should approximate: CHO—55%; Protein—20%; and Fat—25%. This is not the usual SOF pattern. Navy SEAL Mike Fullerton stated that all military members are on the so called "ine diet." "We all wake up at 0-dark thirty, grab a big gulp of java (caffeine), dip a pinch of Skoal (nicotine) and grab a few honey buns from the "gee-dunk" (vending machine)." This pattern of eating over many years comes back with revenge, and makes recovery from strenuous missions more and more difficult. The following other dietary practices are admitted by many SOF operators:

- Consuming the majority of calories at the end of the day.
- Underestimating calories consumed and portions eaten.
- Planning meals poorly.
- Eating too much fast food chow.
- Using multiple dietary supplements to enhance performance.
- Using caffeine and simple sugars to fill the void during the day. The following operations require nutritional countermeasures to avoid complete exhaustion and muscular fatigue:
- Wearing boots and body armor and carrying heavy packs and ammunitions for over 60 minutes.
- Fast roping or dragging a wounded comrade to safety.
- Extended water operations.
- Altitude operations.
- Prolonged shivering in austere environments, such as operating in mountainous regions or diving in cold water.

Fatigue and Glycogen Depletion

Fatigue is a complex phenomenon caused by failure at multiple sites during exercise. The causes of fatigue can be central (mind/central nervous system or neuromuscular) and/or local (peripheral—muscle). One nutritional cause of fatigue is depletion of muscle glycogen. All strenuous exercise, be it endurance, resistance training or missions, will deplete glycogen. Muscle glycogen must be replenished through nutritional interventions to override fatigue and accelerate recovery.

It takes at least 24 hours to replenish muscle glycogen stores following exhaustive exercise or operations. Glycogen repletion occurs when enough CHO is provided. If diet is neglected over time, "staleness" can become a problem.

"Staleness" and Overtraining

The terms "staleness and "overtraining" are consistently noted for competitive athletes and may apply to SOF as well. Staleness and/or overtraining are believed to result from too little recovery time in combination with too much training. Other factors or non-training stressors can also contribute to staleness. A multitude of symptoms are associated with overtraining, including:

- Unexplained, persistently poor performance.
- Moodiness, general fatigue, depression, and irritability.
- Painful muscles.
- Elevated morning resting pulse.
- Insomnia.
- Weight loss.
- Overuse injuries.
- Increased susceptibility to upper respiratory infections and gut problems.

Too rigorous a training program can impair immune function.

How staleness or overtraining is expressed depends upon the physical and physiological makeup of the warrior, type of training regimens, dietary practices, sleep patterns, and various other factors. No single test can identify overtraining, but a number of key markers that change over time have been proposed. Possible markers include stress hormones, immune markers, indicators of muscle damage, compromised muscle glycogen reserves, and decrements in aerobic and anaerobic capacity. Drs. Jack Raglin and William Morgan from Indiana University developed a scale to identify endurance athletes who exhibit signs of distress resulting from intensive training. Called the Training Distress Scale, it consists of ten items that are individually scored and then used to create a total score. If an individual's total score is high over several consecutive days, a couple of days of rest are critical to preserve future performance.

CHO intake over 24 hours will typically not exceed 650 grams.

The Remedy

- Make sure that training is accompanied by periods of rest.
- Ingest a meal providing 1.5 gram of CHO per pound of body weight approximately 4 hours prior to exercise.
- Ingest 0.4 grams of a low GI CHO drink or solid food per pound of body weight 1 hour before exercise/operations.
- Consume an easily digested, high-CHO drink or food that provides approximately 50 grams of CHO and 12 grams of protein within 45 minutes after exercise.
- Consume 0.5 grams of CHO per pound of body weight every 30 minutes until 4 hours after exercise.
- Consume a high CHO drink or solid food providing at least 250 kcal (60 grams) of CHO with each meal.
- Be certain your body weight is stable during all phases of training by matching energy intake to energy requirements.

Nutrient Timing

The timing of "when" nutrients are consumed may be as important as "what" nutrients are consumed.

The timing of nutrients should be viewed as three very distinct phases:

- Recovery or maintenance.
- Exercise when energy stores are being depleted.
- The RFI or critical period after exercise.

During exercise the environment is "catabolic" so that energy can be delivered to the working muscles. Insulin, an important hormone for promoting muscle protein synthesis, is not released during exercise because it is not needed. After exercise the environments must become "anabolic," so the process of recovery and building up what was lost begins: insulin release must be stimulated. Ingestion of CHO stimulates "insulin." Thus, immediately after exercise,

when glycogen stores and muscle protein synthesis are low, is the critical time to provide what the body or muscle needs: CHO with a small amount of protein.

Nutritional intervention within 45 minutes after exercise is the most critical time, or "RFI," for recovery.

Running on an empty tank for too long after strenuous operations or PT will be detrimental to performance and duties the next day. To avoid performance decrements, or fatigue, a CPF of 80%/20%/0%, or as little fat as possible, is recommended. This means a small meal of CHO (50–60 grams) and protein (12–15 grams), taken as food or fluid within 45 minutes after completing exercise, will help begin repletion of muscle glycogen stores and synthesis of muscle protein. This RFI will set the stage for both recovery, repair, and muscular growth.

RFI: Consume 50 g of CHO and 12 g of protein within 45 minutes after training.
More protein may compromise recovery and muscle protein synthesis.

After the first 45 minutes, nutrient intake will depend on the duration, intensity, and type of activity. Low intensity exercise of short duration will require regular meals at regular intervals, whereas high intensity exercise of both short and long duration will require regular snacks of carbohydrate and protein, with some fat. Obviously, the longer the duration of the activity, the greater the energy drain, thus a greater need for refueling the tank.

A recovery meal to ensure nutrients, fluids, and calories are replenished immediately after PT during the RFI and over the course of the day is important. Examples of nutrient-dense recovery foods include the following:

- Sports bar, 1, with 50 g CHO and 12 g protein.
- 100% fruit juice, 8 oz.
- Low-fat yogurt, 8 oz.
- Whole grain bagel, 1.
- Honey, 1 oz.
- Cottage cheese, 4 oz.
- Tuna fish, 3 oz.
- Tomato or V8 juice, 8 oz.
- Whole fruit, 1 piece.
- Homemade trail mix, 6 oz.

These Recovery Meals ensure that nutrient-dense foods, to include carbohydrate-rich, high quality protein, and healthy fats are eaten by SOF personnel at the right time. Commercial Off the Shelf (COTS) products are being used in some SOF commands currently to help provide carbohydrate-rich foods such as sports drinks, bars, and gels during training so they can train and deploy with the same products. These nutrition initiatives have allowed SOF to access nutritionally desirable foods within their commands immediately after PT and in operational settings. Most importantly, COTS are considered "comfort foods" because they are familiar and previously used during phases of training.

All Carbohydrates are NOT Created Equally

Not all CHO foods are equally effective in restoring blood glucose. Certain foods raise blood glucose concentrations and promote glycogen synthesis better than others. The term Glycemic Index is used to describe (and rank) how high a particular food will raise blood glucose; foods with a high glycemic index (GI) are the most effective for restoring glycogen. As shown in the graph, a high GI food produces a "spike" in blood glucose, whereas a low GI food takes a longer time to peak. Immediately after a mission, foods and beverages that have a moderate to high GI should be consumed. During recovery and maintenance, foods with a low GI are preferred.

Rehydration

Fluid requirements can vary from 2–16 liters/day depending on:

- Workload.
- Level of heat stress.
- Sweat rates.

Sweat loss varies depending on age, training, and acclimation status, exercise intensity and duration, air temperature, humidity, wind velocity, cloud cover, clothing, and individual sweat rates.

The adequate fluid intake for men between 19–50 years of age is 13 cups/day. On average, 20–25% of the fluid comes from food and 75–80% from beverages. Plain water, coffee, tea, soups, fruits, and vegetables also provide fluids and support hydration. A small amount of caffeine in tea or coffee (< 200 mg) should not negatively affect hydration status, but if more caffeine is taken in, fluid balance may be negatively affected.

For each liter of sweat lost, a loss between 115–690 mg of sodium is possible in a well-conditioned warrior. If unaccustomed to working in the heat, heavy sweaters can lose as much as 2,500–5,000 mg of sodium per liter of sweat! To individualize fluid and electrolyte recommendations:

- Record weight before and after exercise to determine how much fluid should be replaced.
- Consume 2.5–3 cups of fluid for every pound lost.

Typically, voluntary consumption of fluids will restore only part of the fluid lost. Whenever possible, weigh yourself before and after a training so you can quantify your fluid loss. Your sweat rate during a mission will differ based on the environmental conditions, and this could intensify weight loss.

Over a period of several hours, you should ingest more water and sodium than initially lost. The total replacement volume should be between 125% and 150% of the decrease in body mass. So, if you lost 4 pounds, you would want to take in 5–6 "pounds," or 10–12 cups of water. The fluid **must** be taken in over a period of time rather than at one time. Ingesting 8–16 ounces every 20–30 minutes will allow for water absorption and minimizes water lost by urination. Do not drink more than 48 oz or 1.5 L per hour.

Fluid replacement beverages used during exercise are also appropriate for rehydration. Rehydration beverages containing a higher percentage of CHO than used during exercise are suitable, but it is better to obtain CHO from real foods. Oral Rehydration Solutions (ORS) available through the military medical supply channels can be used, but they are often higher in sodium and lower in CHO than desired.

After a training session or mission, fluid ingestion is essential. Drink at least two 8 oz cups of fluid every 20-30 minutes for two and a half hours after exercise. Each one quart of fluid should contain about one quarter teaspoon of salt.

Rehydration in the Field

A drink that will rapidly promote rehydration, is almost palatable, and contains an acceptable amount of electrolytes (although barely enough potassium) can be made in the field. The fluid is prepared by mixing ¼ strength of a fluid replacement beverage (Gatorade, Powerade, Gookinade or the like) with ¼ strength of a standard ORS. However, this drink will not restore glycogen because it is too low in CHO.

Sodium/Electrolyte Replacement

Sodium and potassium losses in the sweat can be quite high during prolonged physical activity, especially in warm weather. Replacing these elements is an important part of the recovery process. Most commercially available fluid replacement beverages contain electrolytes. Roughly, 1–2 grams of sodium/L of fluid (0.25 teaspoon/quart) will effectively replace the sodium lost during exercise or a mission. Also, sodium is widely present in a variety of foods and fluids, such as bagels, pretzels, tomato juice, sport drinks, and pizza. A bit of salt will speed up rehydration more effectively than plain water. Typical commercial fluid replacement beverages contain both sodium and potassium, but recovery foods should also include foods rich in potassium. Some excellent food sources of potassium are listed to the left. You will notice that these foods are also good sources of CHO and most have a moderate to high GI.

Sports Drinks

Fluids providing CHO and the electrolytes, sodium and potassium, have been shown to sustain athletic performance. The genesis of sports nutrition came about when beverages were created so that CHO, electrolytes, and fluids could be consumed without having to mix, assemble or combine ingredients. The purposes of sports drinks are to:

- Maintain hydration during exercise.
- Ensure rehydration after exercise.
- Replace electrolytes lost during sweating.
- Supplement CHO stores and provide fuel for the working muscles during exercise.

- Minimize muscle from strenuous workouts.
- Protect the immune system.

Although sports drinks containing electrolytes will enhance endurance performance, many people use these drinks as a recreational fluid. This only adds calories, artificial coloring and flavors to their dietary intake. Sports drinks are recommended when exercise is longer than 60 minutes and then, only 8 oz should be ingested every 15 minutes. For activities less than one hour, water is the best choice for hydration needs. Minimal sodium and potassium are lost through sweat and glycogen stores will not be depleted during short, low intensity workouts.

General rules for fluid replacement:

- If you are sweating profusely, try to consume fluids at the rate lost (not to exceed 1.5 L/hour) or as much as tolerated if sweat rate is exceeding the rate of stomach emptying.
- Develop a plan for fluid consumption and practice it during training and operations.
- Sip frequently rather than gulp on occasion; drinking small amounts of fluids at a time are more effective than large amounts only occasionally.
- Start drinking before thirst kicks in.

Drinking sports drinks as recreational fluids only adds calories and artificial coloring and flavors to the diet.

The ideal CHO/electrolyte drink:

- Is not carbonated.
- Empties rapidly from the digestive tract.
- Tastes good.
- Provides energy for exercise > 1 hr.
- Delivers 9–19 grams of CHO per 8 oz.
- Contains sodium and potassium.
- Does not cause digestion problems.
- Is cool (10 to 15°C).

Sports drinks should be used during and after long bouts of exercise in hot and humid conditions. However, if real food and 100% fruit juices are available after exercise, these high CHO foods are the best electrolyte choices. Sodium is still important to take after exercise as it helps increase the desire to drink fluids and improves fluid retention.

To avoid gastrointestinal distress when fluid losses are high (> 4L), beverages should be diluted with water to half of their original strength.

Recovery and Commercial-Off-The-Shelf-Products (COTS)

Many Commercial-Off-The-Shelf (COTS) products are used for recovery. In addition, sport drinks, sports bars, gels, and other similar products are used. Some have many nutrients added, which are usually not needed or are provided in excessive amounts. The Nutrition Committee and the Dietary Supplement Committee within the Department of Defense developed criteria for various COTS categories. The criteria were prepared as guidelines on what products are safe and useful, according to scientific data, because such products are important when real food is not available. The criteria for sports bars and gels are provided below.

Sports Bars

Sports bars originated in the early 1980s when it was shown that ultramarathoners and other endurance athletes did better when provided concentrated sources of easily absorbable CHO during long training runs. Sports bars, in contrast to sport drinks, are solid, so the user must drink water to enhance digestion and absorption.

Criteria for COTS recovery sports bars:

- CHO: $\geq$ 53% of energy.
- CHO/PRO: $\geq$ 4:1.
- Fiber: $\geq$ 1 grams.
- Total Fat: $\leq$ 30% of energy.
- Saturated Fat: $\leq$ 20% of energy.

- No trans fats.
- Sodium: 50-240mg.
- No substances other than vitamins, minerals, protein, and fat.

The Hooah Bar, now known as "Soldier Fuel," is an excellent recovery bar available throughout the military. It must not be mistaken for the old Hooah bar. In 2004 the manufacturer worked closely with Natick Soldier Center researchers to refine, reformulate, and improve the original bar for the military and commercial marketplace. The new bar has been rated highly by all who have tasted it. The Washington Post rated the bar above all other sports bars. The reformulated bar contains no trans fats and provides the requisite amount of CHO and protein for recovery.

Sport Gels

Sport gels were developed in the 1990s in response to complaints by endurance athletes that sports bars were too difficult to digest and absorb when used during exercise. Gels have become increasingly popular for long workouts as they help maintain blood glucose and fuel the tank. However, drinking fluids is essential when using gels. Gels are popular with SOF because they are:

- An absorbable form of CHO, which makes eating on the go easy.
- Lightweight (1 oz) and easy to pack for many long and enduring operations lasting more than 90 minutes.

Gels may be useful after exercise for glycogen repletion when real foods are not available, but are unnecessary for short workouts, regardless of intensity.

Potential Problems with Gels:

Gels are virtually 100% CHO, so it is easy to take in too much, which will lead to GI issues, such as diarrhea. Gels should be tested before combat situations to see which one works best. After over an hour of exercise, 1–2 packets are recommended, but they should be used with water, rather than sports drinks to prevent CHO overload. Listed below are the criteria for gels and various products that meet the criteria.

Criteria for COTS Sport Gels:

- CHO to Protein Ratio: $\geq$ 4:1 ratio if any protein.
- Sodium: $\leq$ 3 mg/g weight.
- Energy: $\leq$ 3 kcal/g weight.
- No substances other than CHO, electrolytes, protein, and caffeine.

These CHO-rich supplements are used more often than needed because they are convenient, easy to use, and provide readily absorbable energy. Many athletes habitually eat sports foods instead of wholesome meals, even though sports products cost more than other foods. Sports drinks cost more than water, sports bars cost more than Fig Newtons, and sports gels cost more than honey.

The right combination of fluids, carbohydrates, proteins and fats in a timely manner will provide the nutritional optimization required for strenuous activities and high impact missions. The body is the vehicle that allows operators to do what they have been trained to do and it must be fed the same way as any vehicle requiring high-octane fuel. The strategies in this chapter will, in the long run, greatly benefit the mission and the operator.